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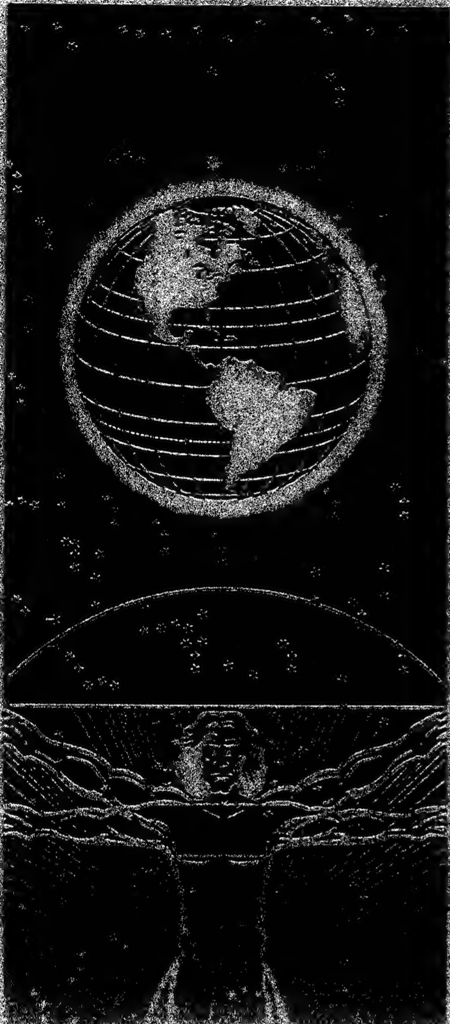

UNITED STATES AIR FORCE RESEARCH LABORATORY

INTERACTIVE MULTIMEDIA COURSEWARE DEVELOPED BY INSTRUCTORS

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14. ABSTRACT

This report documents an evaluation of interactive multimedia courseware (ICW) developed by instructors using Experimental Advanced Instructional Design Advisor (XAIDA) as an authoring tool. The ICW developed by the instructors was implemented in classrooms for evaluation. Instructional effectiveness of the courseware was evaluated on three fronts – how much students learned, efficiency with which they learned, and how they reacted to the learning experience. One hundred seventeen students and staff participated in the evaluation of eight ICW modules developed by their respective instructors. Overall, the courseware produced 8% to 125% increases in scores on factual knowledge tests. Students took from 15 to 36 minutes on average to complete the various courseware modules. The modules presented a nominal class period of 50 minutes. The majority of students had a positive learning experience. Notable is the increase in the percentage of students who prefer self-paced computer-based instruction over instructor-paced computer-assisted instruction (CAI) and group-paced classroom lectures. Before students participated in the evaluation, 40% preferred self-paced CBI, and 34% preferred traditional classroom lectures. After participating in the evaluation, 55% of students preferred self-paced CBI, 27% preferred classroom lectures, and 18% CAI.

15. SUBJECT TERMS

Computer-based Instruction; ICW; Interactive Multimedia Courseware, Training Evaluation

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PREFACE

This research was performed for the Air Force Research Laboratory, Human Effectiveness Directorate, Warfighter Training Research Division (AFRL/HEA) under USAF Contract No. F41624-93-C-5002, and Work Unit 1123-A3-08, Intelligent Instructional Design Methodology. The Laboratory Contract Monitor was Dr Daniel J. Muraida, AFRL/HEAI, at Brooks Air Force Base, TX.

Documentation of this research was delayed due to personnel reassignments and the laboratory reorganization. The original technical monitor was Dr Muraida; however, the final administrative work necessary to publish this report was accomplished by Dr Donald L. Harville, AFRL/HEAI, at Brooks AFB TX.

INTERACTIVE MULTIMEDIA COURSEWARE DEVELOPED BY INSTRUCTORS

BACKGROUND

This report describes the results from classroom evaluations of interactive multimedia courseware. Ten instructors from community colleges across the state of Texas were involved in the project. Each instructor was required to (a) attend two workshops to learn to develop interactive multimedia courseware (ICW) using the Experimental Advanced Instructional Design Advisor (XAIDA), (b) develop at least one lesson using XAIDA, (c) use the courseware in their classroom for purposes of evaluating its instructional effectiveness, and (d) train a colleague to use XAIDA.

Several instructors developed more than one lesson during XAIDA training. The lessons used in the evaluation, the developers, and the campuses involved in the project are listed below in Table 1.

Table 1. Lessons used in the Classroom Evaluation, the Developers, and the Campuses

Lesson Title	/Department	Campus /Location
Confined Space Entry	Occupational Safety and Health	Odessa College, Odessa
Bank Reconciliation	Marketing and Management	South Plains College, Lubbock
Administration of Oral Medication	Nursing	Southwest Texas Junior College,Uvalde
Simpson Analog Meter	Multi-modal Transportation	Southwest Campus, St Philip's College San Antonio
Creating Webpage Links	Technical Communications	Tomball College, Tomball
Linear Equation: Slope-intercept Form	Math	Navarro College, Corsicana
Administering a Z-track Injection	Nursing	Mission del Paso Campus, El Paso Community College El Paso
How to Install RAM	Computer Information Systems	Amarillo College, Amarillo
Taking Blood Pressure	Instructional Technology	St. Philip's College, San Antonio
Catalog and Directory Structures	Computer Information Systems	Brookhaven College, Dallas

The Experimental Advanced Instructional Design Advisor (XAIDA)

XAIDA is a system, developed under the sponsorship of the Air Force Armstrong Laboratory to explore techniques for automatically generating ICW. XAIDA consists of a program called *Develop* for entering and editing lesson topic descriptions and a program called *Deliver* for presenting instruction on the topic. *Develop* provides a subject-matter expert, in this case a community college instructor, with facilities for describing the structure of a topic, describing its characteristics and behavior, associating multimedia with the lesson content, and configuring practice exercises. *Deliver* provides students with an overview of the subject matter, a detailed presentation of lesson material, selective review, and automatically generated practice exercises.

Instructional Materials

Materials used to communicate with students are required as input to XAIDA, in addition to the structure of the topic knowledge. These materials consist mainly of data associated with each part or section in the lesson. For instance, each section requires a textual description and visual representation. Multimedia of all types can be used as instructional materials at various points in the lesson.

Instructional Procedures

Students use *Deliver* to access the ICW generated by XAIDA. The ICW consists of a lesson introduction and body. The introduction is a sequence of textual information and multimedia that the developer assembled to gain the students' attention, activate prerequisite knowledge, and motivate them to learn about the lesson topic. The first instructional elements presented in the introduction is a graphic introducing the lesson followed by a description of the lesson's objective. The last element in the sequence is an outline that shows the structure of the topic being taught. The lesson body proceeds sequentially through the outline. Once an item has been presented to the student the topic is available for review.

Practice exercises are normally invoked whenever a student completes a lesson or subsection within a lesson. Practice consists of interactive exercises that address all of the facts contained in the lesson. Eleven different types of exercises are available which provide practice on recall and recognition of facts. Examples of exercise types include true-false, multiple-choice, and fill-in-the-blank. Practice is fully supported--students can answer on their own, return to the lesson to look up an answer, ask the system to provide an answer, or skip the exercise.

Deliver dynamically constructs each exercise from the knowledge database input by the developer. Developers need only specify the facts that the student is to master. Exercises are generated under the control of a miniature Intelligent Tutoring System (ITS). The ITS maintains a model of the student's knowledge that tracks facts that appear to have been mastered and any misconceptions that have been exhibited. The tutor generates exercises that tend to address unknown facts and misconceptions.

This report is a comprehensive examination of the instructional effectiveness of XAIDA courseware developed by community college instructors from eight different educational domains. The domains include occupational safety and health technology, marketing and management, nursing, multi-modal transportation, math, computer information systems, and instructional technology.

METHOD

Instructional effectiveness of the XAIDA courseware was evaluated on three fronts—how much the students learned, the efficiency with which they learned, and how they reacted to the learning experience.

Minimum computer requirements for running XAIDA *Deliver* were met at all college campuses. All computers used in the evaluations were at least 486 66 MHz with Windows 95 operating systems, with the exception of Amarillo College. The computers at Amarillo College ran under Windows NT. XAIDA has not been systematically tested running under Windows NT. The majority of computer labs ran an application that protected the hard disks as "read only." These applications had to be disabled in order to run the *Deliver* program.

Aspects of instruction that influence learners and courseware's learning potential were investigated across the classroom evaluations. The results are organized around these instructional aspects. They included: (a) contextualized instruction, (b) impact of ICW on task performance, (c) computer-assisted instruction, (d) training staff and faculty, (e) use of humor in instruction, and (f) hands-on practice.

Evaluation Instruments

Evaluation booklets were constructed to assess the instructional effectiveness of the courseware. Booklets contained evaluation instruments constructed and customized for each classroom. Refinements to the instruments were made across evaluations; therefore, not all students responded to identical items.

The final version of the evaluation booklet contained: (a) pre-measures of comfort using computers to learn, self-rated knowledge of the lesson topic and confidence applying that knowledge, and instructional preference [self-paced computer-based training (CBT), group-paced instructor-lead class lecture, or instructor-paced computer-assisted learning (CAI)]; (b) pretest of factual and applied knowledge; (c) written instructions on how to open a lesson, sign-in, and tips on navigating the XAIDA interfaces; (d) posttest; (e) post-measures of computer comfort, knowledge and confidence in the lesson topic area; and (f) a training assessment survey (see Appendix A.

The training assessment survey was designed to measure students' reactions to their learning experience. The survey contained 12 items that represent aspects of sound instruction and the post-measure of instructional preference. Students rated the 12 items based on their learning experience. All ratings were made on a 7-point scale anchored by reciprocal descriptors (e.g., sufficient/insufficient, adequate/inadequate, added to/distracted from). The final item on the survey was a post-measure of instructional preference.

The pretest and posttest were equivalent forms and counterbalanced across booklets. The booklets were randomly distributed to students.

Measures of courseware efficiency were collected from two sources, student data and automatically from XAIDA. Presumably, each courseware module was equivalent in content to a 50-minute classroom lecture. Students participating early in the evaluation project entered their lesson start and stop times in the evaluation booklets. Time on task was computed from the data provided by the students. Later in the evaluation project, time on task was computed from journal

files generated by XAIDA *Deliver*. Journal files are automatically created when users interact with XAIDA. A file contains a time stamped record of interactions between the user and the interface. Thus, a journal file contains entries indicating when a lesson is opened and closed.

RESULTS

Results from eight classroom evaluations are reported in this section. The courseware and approach taken in each evaluation are described below along with the results. Results are discussed in aggregate, as well as at the conclusion of this section of the report.

Paired-sample and independent-sample $\underline{t}$ tests were used in the analyses. Directional tests were used with difference scores. The hypotheses tested were that the differences between post- and pre-instruction test scores, self-ratings, and percentages would be greater than zero. Improvements in factual knowledge, application of that knowledge, and performance were expected after instruction compared to before instruction.

Contextualized Instruction: Confined Space Entry Courseware

An instructor from the Occupational, Safety and Health Technology Department at Odessa College, Odessa, developed a lesson covering the procedures for confined space entry. The objective of the lesson was to be 100% knowledgeable of OSHA regulations for confined space entry. The lesson had seven sections. The developer eliminated practice from the lesson.

Multimedia

The graphics used in the lesson were created by the instructor and student assistant. A scanner was used to create graphics of forms and permits required for the procedure. A digital camera was used to capture actors going through safety procedures for confined space entry. The actors were students enrolled in the occupational safety and health program. The graphics were intended to increase lesson relevance by showing students using equipment at the site where they would be performing their hands-on training. The relevance of the graphics was expected to contribute to student self-efficacy when performing the safety procedures. However, a self-efficacy measure was not collected during hands-on training.

Computer Equipment and Implementation

A computer lab in the Continuing Education Building was the site of the evaluation. The XAIDA *Deliver* software and lesson files were loaded on a server. The software was then copied onto hard drives of 12 Pentiums. The VGA monitors were only capable of handling 16 colors. This lead to a color distortion in the majority of graphics, which were 24-bit true color, presented in the lesson. Color distortion was worse on some monitors than on other monitors. The monitor display areas were set at 640 x 480.

Participants

Two night classes, totaling 14 students, participated in the classroom evaluation of the Confined Space Entry courseware. Data from two students were dropped from the evaluation due to incomplete posttests.

Evaluation Procedures

Students came to class and were instructed to report to the Continuing Education Building for a computer-based lesson on confined space entry. Before beginning the lesson students completed the pre-measures of computer comfort and a 19-item, matching, true/false, and multiple-choice pretest. Students entered their lesson start times before beginning the lesson. Written and verbal instructions were provided on how to use the interface. The instructor and researcher were available to answer questions. No practice exercises were presented on the computer. At the end of the lesson, students entered their stop times and completed a 19-item posttest, 9-item Training Assessment Survey (TAS), and instructional preference item. Students put written comments on the back of their test booklets.

Results

Table 2 contains the mean results from the classroom evaluation. The lesson produced a statistically significant increase in test scores ($\underline{t}(12) = 2.6$, $\underline{p} < .01$). No difference was found in self-ratings of comfort using computers. On average students rated themselves "comfortable" using computers. Over half of the students showed a preference for receiving instruction on confined space entry as self-paced CBT, rather than as classroom lecture.

Table 2. Mean Results from Evaluating the Confined Space Entry Courseware

19-point Pretest score	19-point Posttest score	Knowledge Gain score	Pre-rating of comfort using computers 1- not at all, 7- very	Post-rating of comfort using computers 1- not at all, 7- very	Change in comfort rating using computers 1- not at all, 7- very	Post-measure instructional preference	Time on task in minutes (n = 12)
13.5 (sd = 2.0)	15.1 (sd = 2.1)	1.6 ($\underline{p} < .01$)	5.4 (sd = 2.3)	5.6 (sd = 1.8)	.20 ($\underline{p}$ = NS)	58% CBT 42% Lecture	30.3 (range 15-50)

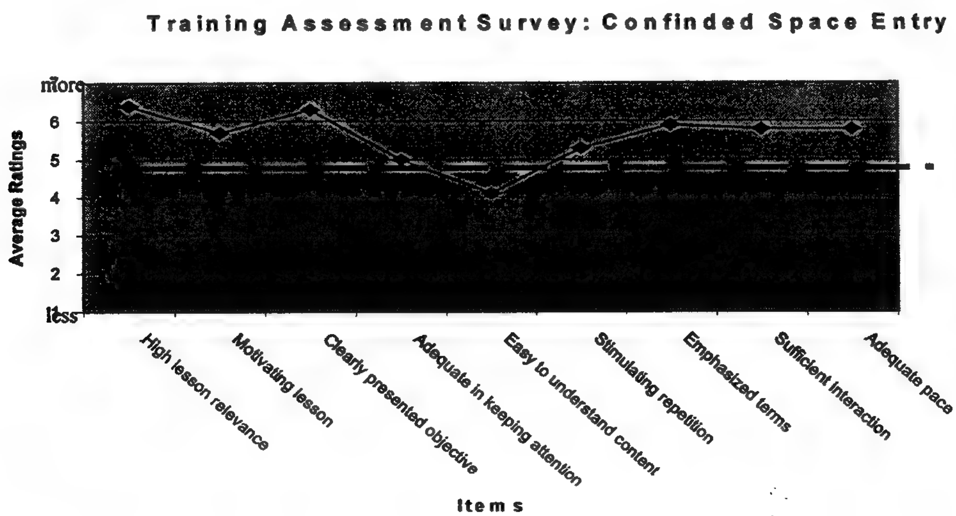


Figure 1. Training Assessment Survey Results for Confined Space Entry Courseware

Results from the training assessment survey are presented in Figure 1. Students rated the survey items, aspects of sound instruction, on a 7-point scale. Reciprocal descriptors anchored the scale end-points, for example, sufficient and insufficient, adequate and inadequate, stimulating and boring. Low numbers signified *unacceptable* and high numbers signified *acceptable* ratings. Average ratings below "5" indicate aspects of the courseware that need improvement.

Overall the courseware received relatively high ratings from the students. The item that measures lesson relevance is critical in validating the ratings for the remaining items on the survey. Students rated lesson relevance sufficiently high ($\underline{M} = 6.4$) to validate the other ratings. *Easy to understand content* ($\underline{M} = 4.1$) was the only item to receive an average rating below "5."

Discussion

The Confined Space Entry courseware was effective in producing a 12% increase in student written test scores. The courseware was very efficient, comparing average time to complete the module to nominal class time of 50 minutes. Allowing students to proceed at their own pace saved on average 40% of classroom time. The time saved could be used to extend hands-on practice with the safety procedure. Hands-on practice could also be staggered to allow students more time with the safety equipment.

The majority of students completing the courseware expressed a preference for the lesson as self-paced CBT over group-paced lecture. Students provided input to improve the courseware. They suggested that titles describing series of steps in the procedure be more explicit. Their suggestion was to use more informative titles (i.e., Obtain the permit, Post the permit, etc.), rather than numbered steps (i.e, Step 1, Step 2, etc). It is likely that the low rating for *easy to understand lesson content* was driven by a potential for confusion from the numeric titles.

An evaluation of the effect of contextualized instruction is needed to determine if contextualization increases learning potential of courseware. Contextualized instruction has the potential to reduce hands-on training time and enhance transfer of training. An evaluation could involve comparing the Confined Space Entry courseware to available CBT, or modifying the current courseware by removing context relevant text and multimedia. An advantage of XAIDA courseware is that it can be readily modified and customized to meet instructional needs.

Impact of ICW on Task Performance

Bank Reconciliation Courseware

An instructor from the Marketing and Management Department at South Plains College, in Lubbock, developed a lesson covering the procedures for reconciling a bank statement. The objective of the lesson was to be able to identify the steps used to reconcile the bank balance and book balance; and be able to perform calculations used in reconciliation. The lesson had two tiers with four sections each. The students were expected to stay in the practice exercises until they mastered 100% of the facts.

Multimedia

The instructor used a scanner to create attention-getting and motivational graphics used in the lesson introduction. A series of graphics that represented changes in the book and bank statements were created in Paint® using colored text for emphasis.

Computer Equipment and Implementation

A computer lab in the same building as the classroom was the site for the evaluation. The lab contained thirty Pentium, 200 MHz computers and an instructor-computer attached to a projector. The instructor-computer was used to demonstrate interface features that the students would be using to navigate the lesson and practice exercises.

A computer lab assistant loaded the XAIDA Deliver software the day before the evaluation. The researcher and instructor loaded the lesson files the day of the evaluation. The software had to be loaded on a per computer basis because the lab was not structured to allow software to be passed across the network. The monitor display areas were set at 640 x 480 and color pallets at 256 colors.

Participants

Two classes, totaling 23 students, participated in the classroom evaluation of the Bank Reconciliation lesson. Fifteen students were enrolled in Basic Accounting and eight students were enrolled in Introduction to Management.

Evaluation Procedures

Students reported to the computer lab at their regularly scheduled class times. Both classes were 50 minutes in duration. Before beginning the lesson students completed the pre-measures of instructional preference (CBT or traditional lecture) computer comfort and a 14-item, multiple-choice pretest. Half of the items on the pretest and posttest measured factual knowledge, while the other half measured applied knowledge. The applied knowledge items required that the students calculate adjusted book balance, and additions and deductions from the bank balance.

Students entered their lesson start times before beginning the lesson. The instructor demonstrated how to use the interface features using the instructor-computer and projector. At the end of the lesson and practice, students entered their stop times, rated their comfort using computers, completed a 14-item posttest, 11-item training assessment survey, and post-measure of instructional preference. Students put written comments on the back of their evaluation booklets.

A problem arose in the practice exercises. A true/false item was discovered to give erroneous feedback. Between classes the lesson was modified to correct the error, although the error persisted with the second class. The error was later found to be due to a corrupt database. Students had been told to ignore the question completely by using the Skip Question button. Nevertheless, the practice item may have had a negative impact on learning.

Results

Table 3 contains the mean results from the classroom evaluation.

Table 3. Mean Results from Evaluating the Bank Reconciliation Courseware

14-point Pretest score	14-point Posttest score	Knowledge/ Performance Gain score	Pre-rating of comfort using computers 1- not at all, 7- very	Post-rating of comfort using computers 1- not at all, 7- very	Change in comfort rating using computers 1- not at all, 7- very	Instructional preference	Time on task in minutes (n = 19)
7.7 (sd = 2.2)	9.0 (sd = 2.6)	1.3 ($p < .005$)	5.41 (sd = 1.3)	5.45 (sd = 1.2)	.04 (p = NS)	<u>Pre-measure</u> 48% CBT 52% Lecture <u>Post-measure</u> 52% CBT 48% Lecture	16.1 (range 12-25)

The lesson produced a statistically significant increase in overall test scores ($t(22) = 2.8$, $p < .005$). The significant gain score was driven by an increase in scores on the seven factual knowledge items ($M_{pretest} = 3.3$, $M_{posttest} = 4.5$; $t(22) = 2.8$, $p < .005$), not the seven applied knowledge items ($M_{pretest} = 4.4$, $M_{posttest} = 4.5$; p = NS). No difference was found in self-ratings of comfort using computers. Students were initially comfortable using computers ($M = 5.4$). Student instructional preferences changed after experiencing the computer-based lesson compared to before the experience. More students preferred that the lesson on bank reconciliation be presented as CBT than group lecture after they experienced the courseware.

Results from the training assessment survey are presented in Figure 2. Students rated the survey items, aspects of sound instruction, on a 7-point scale. Reciprocal descriptors anchored the scale end-points, for example, sufficient and insufficient, adequate and inadequate, stimulating and boring. Low numbers signified *unacceptable* and high numbers signified *acceptable* ratings. Average ratings below "5" indicate aspects of the courseware that need improvement.

Overall the courseware received moderate ratings from the students. The item that measures lesson relevance is critical in validating the other ratings. Students rated lesson relevance sufficiently high ($M = 5.6$). Six other items were rated below the acceptable level. The courseware failed to keep students' attention ($M = 4.5$), lesson content was not easy to understand ($M = 4.4$), practice was less than adequate ($M = 4.6$) and repetition failed to stimulate the students ($M = 4.9$). Taken together the lesson failed to motivate ($M = 4.7$) the students.

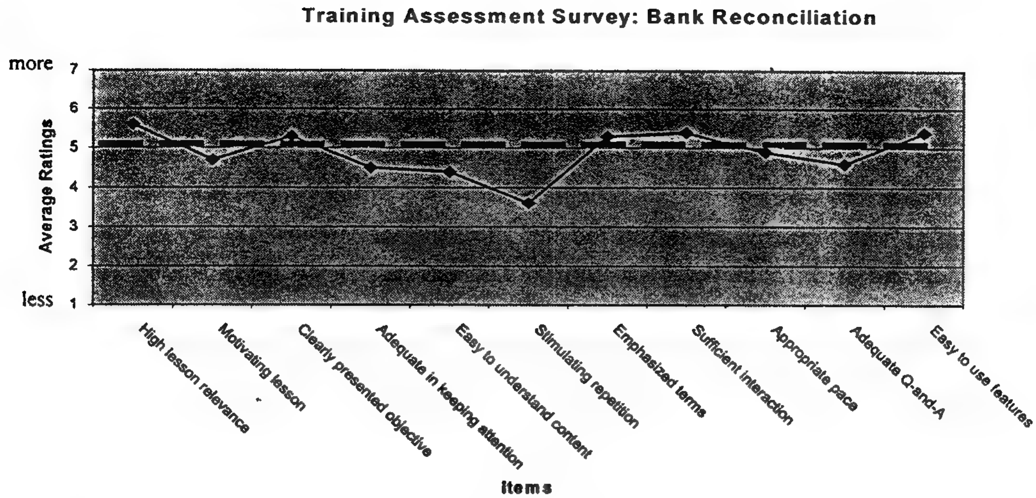


Figure 2. Training Assessment Survey Results for the Bank Reconciliation Courseware

Discussion

The Bank Reconciliation courseware produced a 17% increase in written test scores. However, the courseware failed to improve students' abilities calculating bank and book balances. There were two factors that can account for poor task performance. One factor is the feedback error found in the practice exercises. Although, students were told to skip the question containing the error, the faulty feedback likely had a negative impact on learning. Feedback is a very powerful learning event. Time is the other factor that may explain poor performance. Students had only 40 to 45 minutes to learn the interface, complete the evaluation instruments, and complete the courseware. Undoubtedly, time pressure counteracts the learning potential of self-paced CBT.

More students chose to receive the bank reconciliation lesson as self-paced CBT after their experience compared to before. Student responses to the training assessment survey should be addressed to improve the courseware, given the students expressed interest. The instructor can easily make improvements and modifications, using student input as a guide, to the courseware. Programmers have already corrected the bug found in the feedback generated in practice. Once improvements have been made, the new courseware is expected to produce additional increases in written test scores, improved task performance, and a positive assessment from the students.

The findings from this evaluation suggest that class time needs to be extended for the purpose of evaluating new courseware. Night classes appear to be a good testing ground for self-paced CBT because night classes are normally longer than 50 minutes.

Simpson Analog Multimeter Courseware

An instructor from the Multimodal Transportation Department at St. Philip's College, Southwest Campus, in San Antonio, developed a lesson covering the setup and use of a Simpson Analog Multimeter. The lesson objectives included: possess the ability to setup and use the meter, name the parts of the meter, and identify the function of each part. The lesson had seven

sections. The students were expected to stay in the practice exercises until they mastered 100% of the material.

Multimedia

The instructor used a scanner and digital camera to create the graphics used in the lesson. The instructor used Windows Sound Recorder application to create audio narration. Several graphic and audio files were combined using Adobe Premiere® to create video resources for the lesson. The quality of the audio was poor during the evaluation, for an unknown reason.

The use of multimedia in the lesson was inconsistent. At different points in the lesson, resources were presented as static graphics with narration and redundant on-screen text, others as narration and redundant on-screen text, and others as text only.

Computer Equipment and Implementation

A computer lab in a building near the classroom was the site for the evaluation. Computer lab support personnel loaded the XAIDA software and lesson files from a server on ten Pentium, 120 MHz computers with sound cards and an instructor's computer attached to a projector. Each computer was equipped with a headset. The monitor display areas were set at 640 x 480 and color pallets at 256 colors. The instructor-computer was used to demonstrate interface features that the students would be using to navigate the lesson.

Participants

Eight students enrolled in an aircraft electrical systems class participated in the classroom evaluation of the Simpson Analog Multimeter lesson. Prior to participating none of the students reported being "familiar" with the meter.

Evaluation Procedures

Students reported to the computer lab from their regularly scheduled classroom. Before beginning the lesson students completed the pre-measures of instructional preference (CBT or traditional lecture) computer comfort, familiarity with the meter, and a 14-item, fill-in-the-blank and matching pretest. Half of the items on the pretest and posttest tapped into students' knowledge of part names and the other half tapped into students' knowledge of each part's function.

The instructor demonstrated the XAIDA interface features using the instructor's computer and projector. At the end of the lesson, students completed a 14-item posttest, 12-item training assessment survey, and post-measure of instructional preference. Students put written comments on the back of their evaluation booklets. Following completion of the booklet, students returned to their normal classroom for a performance task. Students were required to setup the meter and measure both resistance and voltage from a circuit board. Six written responses were required for each measurement type. Error rates were tallied across the 12 items.

Results

Table 4 contains the mean results from the classroom evaluation. The lesson produced a statistically significant increase in overall test scores ($t(7) = 6.4$, $p < .0001$). The significant gain score was driven by an increase in scores on the seven naming items ($M_{pretest} = 1.1$, $M_{posttest} = 6.8$; $t(7) = 21.4$, $p < .0001$), not the seven functional items ($M_{pretest} = 4.5$, $M_{posttest} = 5.8$; p = NS). No statistical difference was found in self-ratings of comfort using computers. After the lesson, 50% of the class categorized themselves as being at least "familiar" with the multimeter. Initially no student indicated being "familiar" with the meter.

Table 4. Mean Results from Evaluating the Simpson Analog Multimeter Courseware

14-point Pretest score	14-point Posttest score	Knowledge/ Performance Gain score	Pre-rating of comfort using computers 1- not at all, 7- very	Post-rating of comfort using computers 1- not at all, 7- very	Change in comfort rating using computers 1- not at all, 7- very	Instructional preference	Time on task in minutes (n = 8)
5.6 (sd = 1.9)	12.5 (sd = 2.0)	6.9 ($p < .0001$)	4.5 (sd = 1.3)	4.0 (sd = 1.6)	-.5 (p = NS)	<u>Pre-measure</u> 33.3% CBT 33.3% Lecture 33.3% CAI <u>Post-measure</u> 50% CBT 25% Lecture 25% CAI	30.5 (range 19-40)

On average students committed .8 errors measuring resistance and 1.3 errors measuring volts. Fifty percent of the students performed both measures without error. A common error generated by students was failing to shut off power and touch leads together to adjust the meter to zero, prior to taking a resistance reading.

Student instructional preferences were equally dispersed among CBT, lecture, and CAI before experiencing the courseware. Fifty percent of the students preferred the lesson on the Simpson Analog Multimeter as self-paced CBT after they had the XAIDA experience. The remainder of student preferences was evenly split between lecture and CAI.

Results from the training assessment survey are presented in Figure 3. Students rated the survey items, aspects of sound instruction, on a 7-point scale. Reciprocal descriptors anchored the scale end-points, for example, sufficient and insufficient, adequate and inadequate, stimulating and boring. Low numbers signified *unacceptable* and high numbers signified *acceptable* ratings. Average ratings below "5" indicate aspects of the courseware that need improvement.

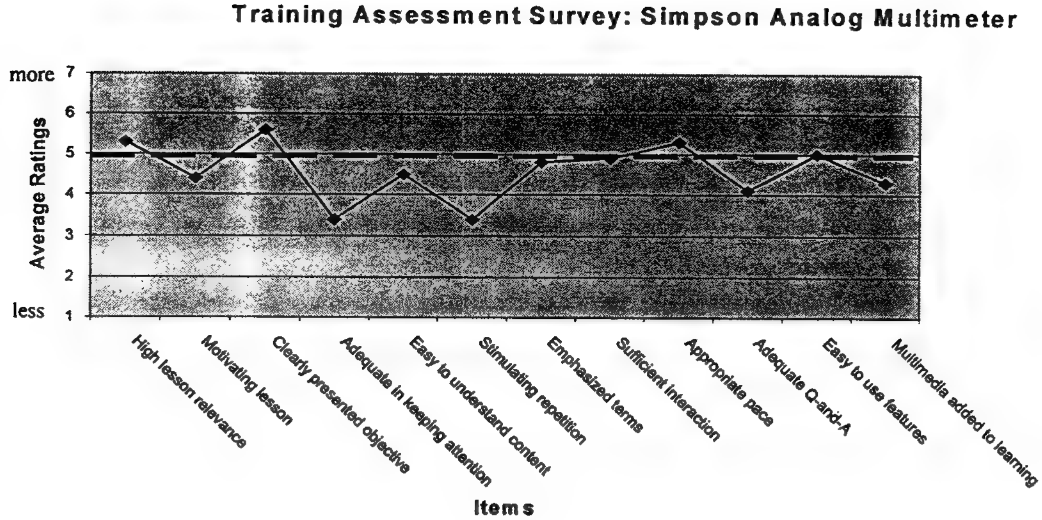


Figure 3. Training Assessment Survey Results for the Simpson Multimeter Courseware

Overall the courseware received low ratings from the students. The item that measures lesson relevance is critical in validating the remaining ratings. Students rated lesson relevance sufficiently high (M = 5.3) to validate the other ratings. Eight of the 12 items were rated below an acceptable level. The courseware failed to keep students attention (M = 3.4), lesson content was not easy to understand (M = 4.5), practice was less than adequate (M = 4.1), terms were not effectively emphasized (M = 4.8), repetition failed to stimulate the students (M = 3.4), multimedia failed to add to learning (M = 4.3), and personal interactions were less than sufficient (M = 4.9). Taken together the lesson failed to motivate (M = 4.4) the students.

Discussion

The Simpson Analog Multimeter courseware did produce 123% increase in average knowledge gain scores. The courseware was very efficient, comparing average time of 30.5 minutes to complete the module to nominal class time of 50 minutes. Allowing students to proceed at their own pace saved on average 40% of classroom time.

Students did not report having a completely positive experience with the courseware, nor did they report being comfortable learning from computers, although the experience swayed students' instructional preference toward self-paced CBT. Afterward, half of the students would prefer to receive instruction on the Simpson Analog Multimeter as self-paced CBT; whereas before only one-third of the students were interested in receiving instruction as self-paced CBT. Even though students assessed their lesson as unmotivating, less than adequate in keeping their attention and providing practice, more difficult to understand than they had hoped, and found the multimedia to distract from learning; they managed to increase their average test scores by 123%.

The results from the evaluation suggest that research is needed to better understand how students learn from computers. Potentially, perceived deficiencies in the courseware are an artifact of students not being skilled at using computers as learning tools.

Linear Equations in Slope-Intercept Form Courseware

An instructor from the Math Department at Navarro College, in Corsicana, developed a lesson covering linear equations in slope-intercept form. The objective of the lesson was to teach students how to convert an equation into slope-intercept form and use it to graph a line. The lesson was intended to help students prepare for the TASP test by providing a platform to practice matching equations to graphs. Students were expected to continue practicing until they mastered 100% of the material.

Multimedia

The instructor reused a basic graphic from the lesson developed the previous year. The instructor created video files using Adobe Premiere® by interleaving audio (WAV) and graphic (BMP) files. The video files produced the effect of an animated white board.

The instructor originally created the audio files using Windows 95 Sound Recorder. However, the poor sound quality was improved upon by re-recording the audio at Mei Technology Corporation.

Computer Equipment and Implementation

A computer lab in the same building as the classroom was the site for the evaluation. The lab contained 20 Pentium 266 MHz towers with sound cards. Each computer was equipped with a headset. The length of the headset cords was incompatible with the physical layout of the computer lab. Use of the headsets was uncomfortable for the students, as it did not allow for freedom of movement.

The researcher loaded the XAIDA *Deliver* software and courseware files in the lab prior to the evaluation. Two video files had to be omitted from the lesson because the computers lacked the software to decompress the files. The software had to loaded on a per computer basis, as the lab was not structured to allow software to be passed across a network. Also, the software application that "write protects" the hard drive had to be disabled during the evaluation.

Participants

A class of nine students participated in the evaluation of the Linear Equation in Slope-intercept Form courseware. The students were enrolled in the second summer session Math Seminar for TASP.

Evaluation Procedures

Students reported to the computer lab instead of their classroom at their regularly scheduled class time. Before beginning the lesson students completed the pre-measures of instructional preference, computer comfort, familiarity with the lesson topic, and a 15-item, multiple-choice pretest. Items on the pretest and posttest measured factual knowledge and

applied knowledge (e.g., converting equations into slope-intercept form, matching equations to graphs). Applied items were similar to those found on the TASP test.

Verbal and written instructions were provided on use of the interfaces. At the end of the lesson and practice, students completed a 15-item posttest, 12-item training assessment survey, and post-preference item. Students put written comments on the back of their booklets.

Results

Table 5 contains the mean results from the classroom evaluation. The lesson produced a statistically significant gain score ($t(9) = 6.1$, $p < .0001$). A significant difference was also found in self-ratings of familiarity with the topic of linear equations in slope-intercept form ($M_{pre} = 2.9$, $M_{post} = 4.0$; $t(8) = 2.0$, $p < .04$). Increases in student comfort using computers for learning approached significance ($M_{pre} = 5.0$, $M_{post} = 5.8$; $t(8) = 1.7$, $p < .07$). Familiarity and comfort rating were made on a 7-point scale where larger numbers represented *more* of the characteristic.

Student instructional preferences changed after experiencing the computer-based lesson compared to before the experience. More students preferred the lesson on linear equations in slope-intercept form be presented as instructor-paced CAI (44%) than as either self-paced CBT (33%) or group-paced lecture (22%), after they had the XAIDA experience.

Table 5. Mean Results from Evaluating the Slope-Intercept Form Courseware

14-point Pretest score	14-point Posttest score	Knowledge/ Performance Gain score	Pre-rating of comfort using computers 1- not at all, 7- very	Post-rating of comfort using computers 1- not at all, 7- very	Change in comfort rating using computers 1- not at all, 7- very	Instructional preference	Time on task in minutes ($n = 9$)
4.9 (sd = 3.5)	9.8 (sd = 3.5)	4.9 ($p < .0001$)	5.0 (sd = 1.7)	5.8 (sd = 1.4)	.8 (p = NS)	<u>Pre-measure</u> 33.3% CBT 33.3% Lecture 33.3% CAI <u>Post-measure</u> 33.3% CBT 22.2% Lecture 44.4% CAI	26.7 (range 16-41)

Results from the training assessment survey are presented below in Figure 4. Students rated the survey items, aspects of sound instruction, on a 7-point scale. Reciprocal descriptors anchored the scale end-points, for example, sufficient and insufficient, adequate and inadequate, stimulating and boring. Low numbers signified *unacceptable* and high numbers signified *acceptable* ratings. Average ratings below "5" indicate aspects of the courseware that need improvement.

Overall the courseware received acceptable ratings from the students. The item that measures lesson relevance is critical in validating the remaining ratings. Students rated lesson relevance sufficiently high ($M = 5.7$) for validation purposes. The amount of repetition in the

lesson was less than stimulating to the students ($\underline{M} = 3.9$). This repetition and the motivational capacity of the lesson ($\underline{M} = 4.7$) were the only items to receive average ratings below "5."

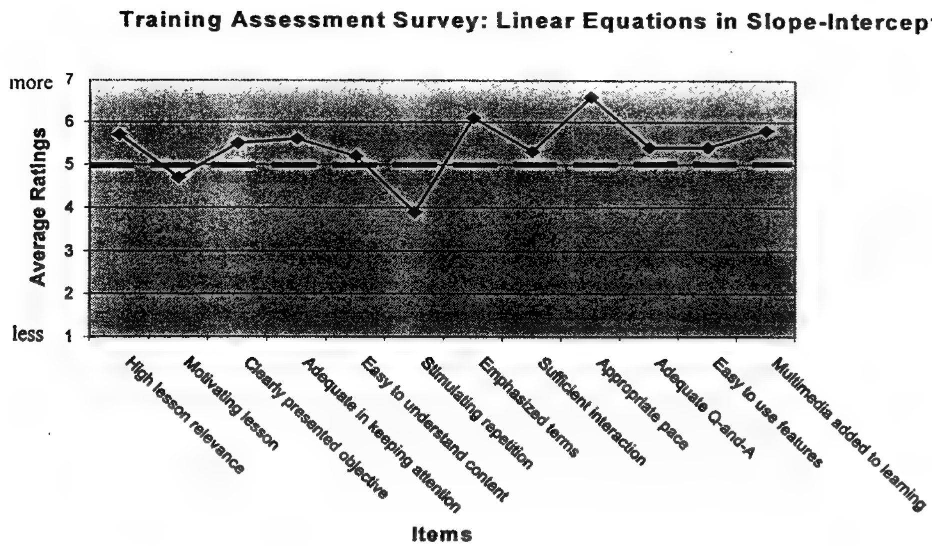


Figure 4. Training Assessment Survey Results for Slope-Intercept Form Courseware

Discussion

The Linear Equations in Slope-Intercept Form courseware produced a 100% increase in performance scores. The courseware was very efficient, comparing average time of 26.7 minutes to complete the module to nominal class time of 50 minutes. Allowing students to proceed at their own pace saved on average nearly 50% of classroom time.

The students liked the idea of learning from computers, although they would rather the instructor maintain control over what information is presented when. Interactivity that is built into the courseware making it self-paced, requires the student take responsibility for what information is presented when. This feature may demotivate students who require more guidance in learning.

ICW Implemented as CAI: Oral Medication Administration Courseware

The LVN program director at South Texas Junior College, in Uvalde, developed a lesson covering the administration of oral medication. The objective of the lesson was to be able to identify the five steps used in the administration of oral medications. The lesson had five sections.

The class had received a lecture on oral medication administration earlier in the semester. The instructor, therefore, decided to present the lesson as computer-assisted instruction (CAI). The instructor controlled the pace of the lesson by presenting it on a large screen at the front of the classroom. The evaluation was the first implementation of an XAIDA lesson as CAI.

Multimedia

The instructor used a scanner and Paint® to create the graphical resources used in the lesson. An instructional technologist at St Philip's College captured the video files used in the lesson from a nursing videotape.

Computer Equipment and Implementation

A Pentium 233 MHz MMX Dell computer attached to a projector system served as the instructional platform. The classroom was equipped with a pull-down screen. XAIDA *Deliver* software was loaded onto the computer hard drive. The lesson ran off of a CD.

Participants

Twenty-nine students enrolled in the Advanced Nursing Skills course participated in the classroom evaluation of the Administration of Oral Medication lesson. The LVN program requires that students have 20 hours of instruction on the computer. Participation counted toward that requirement.

Evaluation Procedures

Students reported to class at their regularly scheduled time. Before beginning the lesson students completed pre-measures of instructional preference (self-paced CBT, traditional group-paced lecture, or instructor-paced CAI) computer comfort and a 10-item, multiple-choice pretest.

The instructor presented the lesson at the front of the class. Class participation was encouraged throughout presentation of lesson content. A response sheet for practice items was included in the test booklet. Students initially provided written responses to the practice items followed by verbal responding. However, written responses were replaced with √s after several multiple-choice and fill-in-the-blank exercises required up to five responses. Multiple responses were timely and cumbersome to write in the space provided. A √ represented that the student knew the answer. Following the practice exercises, post-measures of computer comfort, posttest, and 12-items training assessment survey with post-preference measure were administered.

Results

Table 6 contains the mean results from the classroom evaluation. The lesson produced a statistically significant but small increase of .7 points in test scores ($t(28) = 3.3$, $p < .001$). The small gain score can be explained as a "ceiling effect" given that the average pretest score of 8.8 does not leave much room for improvement. Students rated their comfort using computers higher after experiencing CAI. No real change was found in instructional preferences after versus before experiencing CAI. Nearly 80% of the class showed a preference for learning with computer-based instruction.

Results from the training assessment survey are presented in Figure 5. Students rated the survey items, aspects of sound instruction, on a 7-point scale. Reciprocal descriptors anchored the scale end-points, for example, sufficient and insufficient, adequate and inadequate, stimulating and boring. Low numbers signified *unacceptable* ratings and high numbers signified *acceptable* ratings. Average ratings below "5" indicate aspects of the courseware that need improvement.

Table 6. Mean Results from Evaluating the Oral Medication Administration Courseware

10-point Pretest score	10-point Posttest score	Knowledge Gain score	Pre-rating of comfort using computers 1-not at all, 7- very	Post-rating of comfort using computers 1- not at all, 7- very	Change in comfort rating using computers 1- not at all, 7- very	Instructional preference
8.8 (sd = .99)	9.5 (sd = .69)	.7 (p < .001)	4.7 (sd = 1.9)	5.2 (sd = 1.7)	.37 (p < .03)	Pre-measure 53% CBT 17% Lecture 29% CAI Post-measure 55% CBT 17% Lecture 28% CAI

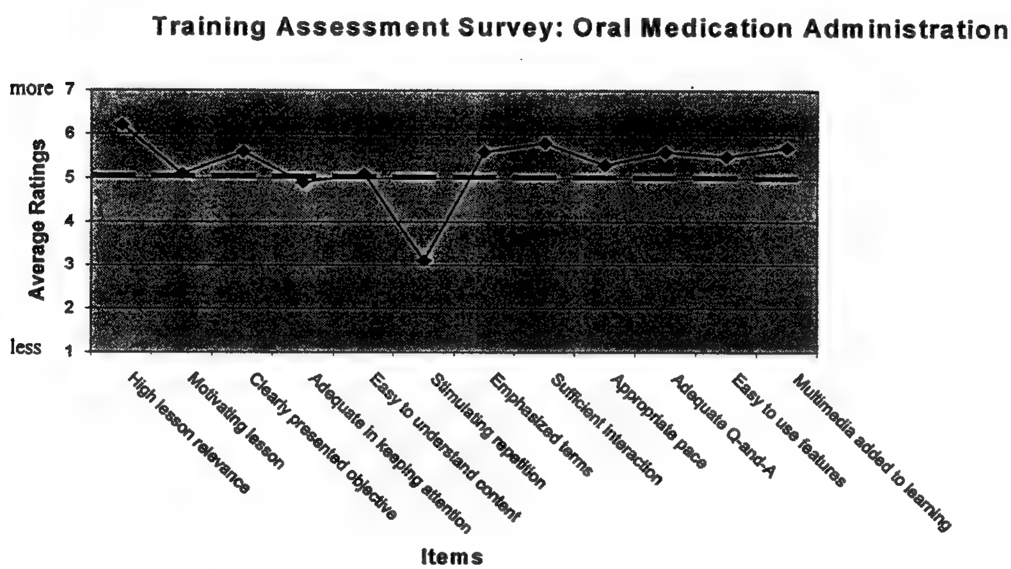


Figure 5. Training Assessment Survey Results for Oral Medication Courseware

The item that measures lesson relevance is critical to the validity of the remaining survey items. Students rated lesson relevance sufficiently high ($\underline{M}$ = 6.2) for purposes of validation. Overall the courseware received acceptable ratings from the students, with the exception of the repetitiveness. The amount of repetition in the lesson was less than stimulating to the students ($\underline{M}$ = 3.1). The source of the repetitiveness is most likely found in the practice exercises. Practice is designed to drill the students until they possess mastery of the facts presented in the lesson. Students perceived the lesson as motivating ($\underline{M}$ = 5.1), although the instructional sequence was not able to keep students' full attention ($\underline{M}$ = 4.9).

Discussion

The Oral Medication Administration courseware is the first effort at implementing XAIDA as computer-assisted instruction. The courseware produced an 8% increase in knowledge gain scores. The percent gained would likely have been higher had the class not previously been lectured on the lesson topic. Regardless, the students reported having an overall positive experience with CAI. The class as a whole expressed interested in computer-based instruction.

Training Faculty and Staff Using ICW: Linking Files to a Webpage Courseware

A technology communications instructor at Tomball College, in Tomball, developed a lesson covering the steps to linking files to a WebPage using Netscape Composer®. The objective of the lesson was to understand how to use features of Netscape Composer® to link files to a Webpage. The lesson had five sections.

Multimedia

The instructor used screen captures of the Netscape Explorer® interface imported into Paint® to create the graphical resources used in the lesson. The instructor created audio narration to accompany the graphical representations of the procedure. Music and audio narration were used to gain students' attention in the lesson introduction and throughout the lesson. However, the use of multimedia was inconsistent.

Computer Equipment and Implementation

A computer lab with Pentium 90 MHz computers was the site of the evaluation. Computer lab personnel loaded the XAIDA *Deliver* software from a server onto ten computers. The researcher loaded the lesson files onto each computer. Verbal instructions on using the XAIDA interfaces were provided individually to each participant.

Participants

Eight staff and faculty at Tomball College volunteered to participate in the evaluation. Fifty percent of participants reported that they had no ability using Netscape Composer® to link files to WebPages. Approximately 37% of participants reported having *fair* to *good* ability.

Evaluation Procedures

Participants came into the computer lab within a designated time slot. Each individual was given an evaluation booklet and verbal instructions on how to begin the lesson. Before beginning pre-measures were collected on self-ratings of computer comfort, knowledge of how to link files using Netscape Composer®, ability to link files using Netscape Composer®, instructional preference, and a 10-point multiple-choice test. Participants remained in practice at the end of the lesson until they mastered 100% of the facts. The posttest and training assessment survey with a post-measure of instructional preference was administered following practice.

Results

Table 7 contains the mean results from the evaluation. The lesson produced a statistically significant increase in overall scores ($\underline{t}(7) = 2.3$, $\underline{p} < .03$). The computer comfort average rating of 6.3 was the high-end of the 7-point scale and showed no change after instruction. However, a significant increase was found after instruction ($\underline{M}_{pre} = 3.0$, $\underline{M}_{post} = 4.4$; $\underline{t}(7) = 2.3$, $\underline{p} < .03$) in

ratings for level of knowledge about how to link files using Netscape Composer®. After instruction the average rating for ability to link files using Netscape Composer® was significantly higher than the average rating before instruction ($\underline{M}_{pre} = 3.1$, $\underline{M}_{post} = 4.9$; $\underline{t}(7) = 2.4$, $\underline{p} < .02$). The 7-point ability scale was labeled with *no ability* (1), *poor ability* (3), *fair ability* (5), and *good ability* (7). All participants reported having some level of ability using Netscape Composer® to link files to WebPages following instruction. Of those participants responding, approximately 63% reported their ability between *fair* and *good.*

Table 7. Mean Results from Evaluating the Linking Files to WebPages Courseware

10-point Pretest score	10-point Posttest score	Knowledge Gain score	Pre-rating of comfort using computers 1- not at all, 7- very	Post-rating of comfort using computers 1- not at all, 7- very	Change in comfort rating using computers 1- not at all, 7- very	Instructional preference	Time on task in minutes (n = 6)
6.4 (sd = 1.9)	7.9 (sd = 1.4)	1.5 ($\underline{p} < .03$)	6.3 (sd = 1.0)	6.3 (sd = 1.0)	0.0 ($\underline{p}$ = NS)	<u>Pre-measure</u> 100% CBT <u>Post-measure</u> 62.5% CBT 12.5% Lecture 25.0% CAI	18.3 (range 10-26)

Results from the training assessment survey are presented in Figure 6. Students rated the survey items, aspects of sound instruction, on a 7-point scale. Reciprocal descriptors anchored the scale end-points (e.g., sufficient and insufficient, adequate and inadequate). Low numbers signified *unacceptable* ratings and high numbers signified *acceptable* ratings. Average ratings below "5" indicate aspects of the courseware that need improvement.

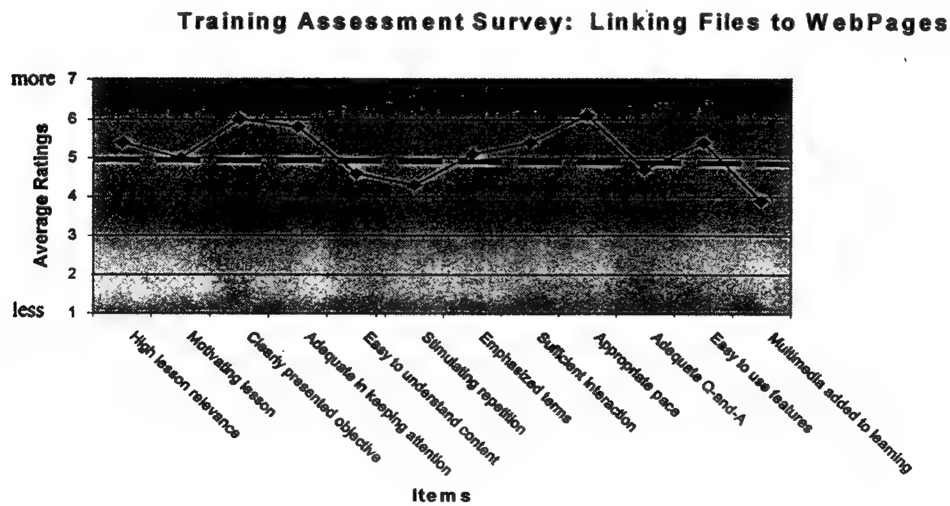


Figure 6. Training Assessment Survey Results for Linking Files to WebPages Courseware

Overall the courseware received moderate ratings of acceptability from the users. The item that measures lesson relevance is critical to validating the ratings for the remaining survey items. Students rated lesson relevance in the acceptable range (M = 5.4) for purposes of validation. Lesson content was not easy to understand (M = 4.6). The amount of repetition in the lesson was less than stimulating to the users (M = 4.3) and the use of multimedia did not add to learning (M = 3.9). However, users perceived the lesson as motivating (M = 5.0).

Discussion

The Linking Files to a Webpage courseware produced a 23% increase in faculty and staff's factual knowledge about Netscape Composer®. The courseware also produced increases in faculty and staff's self-perceived levels of knowledge and ability using Netscape Composer® to link files to Webpages.

Results from the training assessment survey suggest that improvements should be made to the courseware. Practice exercises need to be examined and modified to better target the objective of the lesson. The multimedia needs to be examined and modified to better communicate important information to the user.

The shift in users' instructional preference from 100% self-paced CBT to 63% suggests that students require a guide to help them learn Netscape Composer®.

Impact of Humor on Learning: Installing RAM Courseware

The Computer Information Systems Department Head at Amarillo College, in Amarillo, developed a lesson covering the steps to installing Random Access Memory (RAM). The objective of the lesson was to be able to identify and recall the critical steps to installing SIMM RAM in a microcomputer, and be able to recognize computer jargon associated with the installation process. The lesson was presented in four sections.

Two courseware modules, humorous and non-humorous, were created for the evaluation. They differed on four graphics. The instructional content of the courseware was held constant. We expected the students receiving the humorous courseware/graphics to have a more positive learning experience than the students receiving the non-humorous courseware/graphics.

XAIDA courseware can be readily modified, which is one of the attractive feature of XAIDA as an authoring tool. The developer merely gave identical file names to the pairs of humorous and non-humorous graphics in order to create the two distinct lessons.

Multimedia

The instructor scanned in graphics from various sources. Mei Technology Corporation used a digital camera to create other graphics showing a person installing RAM, an actual SIMM chip, and the proper manner to handle the chip.

Computer Equipment and Implementation

A computer lab with Pentium 90 MHz computers running Windows NT was the site of the evaluation. A computer with a projector served as a demonstration platform. Windows NT crashed before the second group received a demonstration of the interface. Only verbal instructions were provided to the second group.

Participants

Twenty-five students enrolled in the Computer Concepts course, offered during the second summer session, participated in the evaluation.

Evaluation Procedures

Participants reported to their regularly scheduled classroom. The class was split into two groups. The first group had another class scheduled immediately following their Computer Concepts class. The second group had no other classes scheduled in the morning.

After the class was split, the first group completed the pretest portion of the evaluation booklet and reported to the computer lab. Participants were randomly assigned to either the humorous or non-humorous courseware. The first group was given a demonstration, written and verbal instructions on how to begin the lesson and use the interfaces. The second group did not get a demonstration of the interfaces.

Participants completed the lesson and remained in practice until they mastered 100% of the facts. The posttest and training assessment survey was administered following the practice exercises. An item measuring the level of humor in the courseware was added to the training assessment survey as a manipulation check.

A retention measure was collected one week following the original evaluation. The measure included items from both forms of the original tests with improved distracters.

Results

Table 8 contains the mean results from the classroom evaluation. The humor manipulation was effective (t (23) = 2.6, $p < .01$). The group that took the humorous lesson (M = 5.3) gave it a significantly higher humor rating on a 7-point scale than the group that took the non-humorous lesson (M = 3.5).

Table 8. Mean Results from Evaluating the Installing RAM Courseware

14-point Pretest score	14-point Posttest score	Knowledge Gain score	Pre-rating of comfort using computers 1- not at all, 7- very	Post-rating of comfort using computers 1- not at all, 7- very	Change in comfort rating using computers 1- not at all, 7- very	Instructional preference	Time on task in minutes (n = 22)
5.5 (sd = 2.0)	12.4 (sd = 1.9)	6.9 ($p < .0001$)	4.4 (sd = 1.3)	5.3 (sd = 1.4)	.90 ($p < .005$)	<u>Pre-measure</u> 32% CBT 28% Lecture 40% CAI <u>Post-measure</u> 68% CBT 12% Lecture 20% CAI	31.6 (range 20-50)

The lesson produced a statistically significant increase in overall test scores (t (24) = 16.2, $p < .0001$) on the 14-item written test. Statistical differences were found across the board on the self-ratings. Larger means reflect "more" of the characteristic: comfort using computers ($M_{pretest}$ = 4.4, $M_{posttest}$ = 5.3, M_{diff} = .9; t (24) = 2.8, $p < .005$), knowledge about installing RAM ($M_{pretest}$ = 2.2, $M_{posttest}$ = 5.3, M_{diff} = 3.1; t (24) = 8.8, $p < .0001$), confidence in apply that knowledge ($M_{pretest}$ = 3.0, $M_{posttest}$ = 5.0, M_{diff} = 2.0; t (24) = 6.3, $p < .0001$), and confidence in computer skills overall ($M_{pretest}$ = 3.9, $M_{posttest}$ = 4.6, M_{diff} = .7; t (24) = 4.0, $p < .0005$). There was no effect of humor on any of the aforementioned difference scores.

Student instructional preferences changed after experiencing the courseware compared to before the experience. More students preferred the lesson on installing RAM be presented as CBT than either group lecture or CAI after they had the XAIDA experience. Nearly twice as many students chose CBT as their instructional preference after the lesson than before the lesson. Retention data collected from 21 of the participants revealed no significant loss in learning ($M_{retention}$ = 12.1; t (19) = .24, p = NS).

Results from the training assessment survey are presented in Figure 7. Students rated the survey items, aspects of sound instruction, on a 7-point scale. Reciprocal descriptors anchored

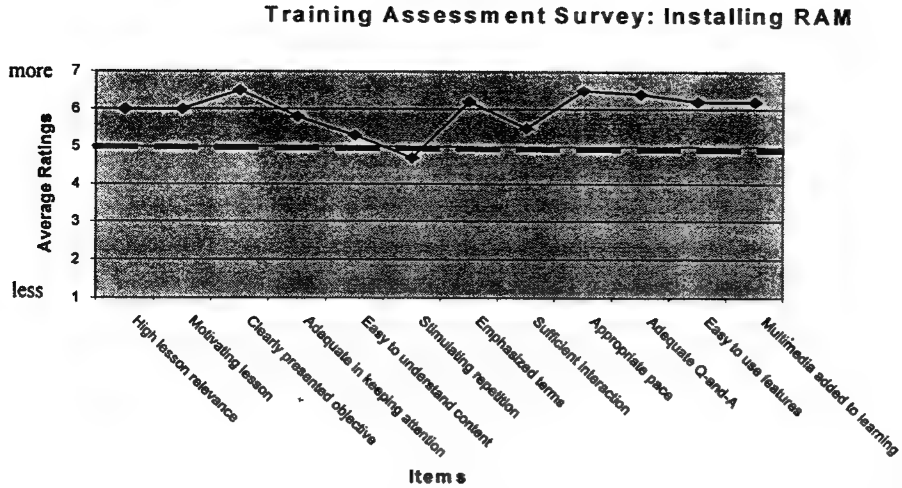


Figure 7. Training Assessment Survey Resutls for Installing RAM Courseware

the scale end-points, for example, sufficient and insufficient, adequate and inadequate, stimulating and boring. Low numbers signified *unacceptable* ratings and high numbers signified *acceptable* ratings. Average ratings below "5" indicate aspects of the courseware that need improvement.

Overall the courseware received high ratings of acceptability from the students. Students rated all aspects of the courseware as *acceptable*, with the exception of repetition ($\underline{M} = 4.7$).

Students who experienced the humorous courseware reported a more positive learning experience, as expected. Use of humorous graphics affected students' perception of the multimedia and motivational capacity of the courseware. Students receiving the humorous courseware perceived the multimedia as contributing to learning ($\underline{M}_{Humor} = 6.5$, $\underline{M}_{No\ Humor} = 5.8$; $\underline{t}(23) = 1.7$, $\underline{p} < .05$) and the courseware as being more motivating ($\underline{M}_{Humor} = 6.5$, $\underline{M}_{No\ Humor} = 5.6$; $\underline{t}(23) = 1.8$, $\underline{p} < .04$) than the students receiving the non-humorous courseware.

Discussion

The Installing RAM courseware produced a 125% increase in knowledge gain. The courseware was completed on average in 32 minutes producing a 37% savings in class time. Students showed a strong preference for self-paced CBT after their experience with the courseware. Plus, after their experience, students self-reported being more comfortable learning from computers.

The only negative reaction students had to the courseware was the repetitiveness of content. Although the repetitiveness was perceived as less than stimulating, it did enhance learning. For instance, as one student commented, "I liked it !! Now I know how to insert RAM. Drilled it into my head." It is likely that students had somewhat biased perceptions because they were enrolled in a CIS class.

Hands-on Practice and ICW: Administering a Z-track Injection Courseware

A nursing instructor at El Paso Community College, in El Paso, developed a lesson covering the steps to administering a Z-track intramuscular injection. The objective of the lesson was to identify the steps used to administer medication via the Z-track intramuscular injection. The lesson had two tiers, each with three sections.

The participating class was randomly split into two-groups between completion of the courseware and completion of the post-measures. One group completed the evaluation booklet and then practiced administering a Z-track injection into a gel cushion (see Figure 8). The other group practiced administering the injection then completed the post-measures of self-report levels of knowledge and confidence administering a Z-track injection. Although the sample size was small, we expected to see higher confidence ratings for the group that had hands-on practice before they completed the evaluation booklet compared to the group that practiced after they completed the booklet.

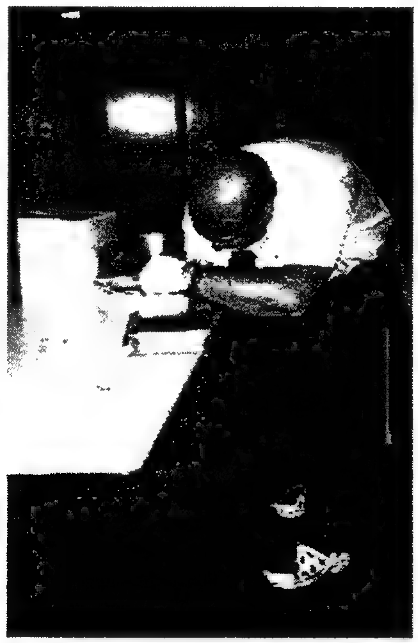


Figure 8. Nursing Student Hands-on Practice Administering a Z-track Injection

Multimedia

The instructor used graphics scanned from a nursing textbook. Adobe Premiere® was used to crop and resize the graphics.

Computer Equipment and Implementation

A computer lab at the Mission Del Paso Campus was the site for the evaluation. The computer lab contained 25 Pentium 166 MHz computers. The computers were in a workstation configuration with sunken monitors and glare shields (See Figure 9). A computer attached to a projector was used to demonstrate how to navigate the interfaces.

Computer lab staff disabled the "write protect" program on each computer. This allowed the researcher, an assistant, and the instructor to load the XAIDA Deliver software, courseware files, and set the parameters for the monitor color pallet (24-bit) and display area (640 X 480).

Participants

Eleven students enrolled in a summer nursing course taught by another instructor participated in the evaluation.

Evaluation Procedures

Participants reported to their regularly scheduled classroom. They were then instructed to report to the computer lab located in the library. The class was given a demonstration, verbal, and written instructions on how to open the lesson, sign-in, and use the interfaces.

Participants completed pre-measures, the lesson, and remained in practice until they mastered 100% of the facts. The posttest was administered immediately following the practice exercises. Half of the participants completed the self-report knowledge and confidence items and training assessment survey immediately following the practice exercises. The other half completed the self-report items and training assessment survey after they had hands-on practice administering a Z-track injection.

Figure 9. Classroom Evaluation Conducted in Computer lab at Mission del Paso

Results

Table 9 contains the mean results from the classroom evaluation. The courseware produced a statistically significant increase in overall test scores ($\underline{t}(10) = 4.9$, $\underline{p} < .0005$) on the 13-item written test. The courseware also produced significant increases in self-reported knowledge of ($\underline{M}_{pretest} = 1.5$, $\underline{M}_{posttest} = 5.2$, $\underline{M}_{diff} = 3.7$; $\underline{t}\,(10) = 26.5$, $\underline{p} < .0001$), and confidence in ($\underline{M}_{pretest} = 1.6$, $\underline{M}_{posttest} = 4.9$, $\underline{M}_{diff} = 3.3$; $\underline{t}\,(10) = 7.6$, $\underline{p} < .0001$) administering the Z-track injection. No difference was found across the evaluation in self-reported confidence in overall nursing skills ($\underline{M}_{pretest} = 4.8$, $\underline{M}_{posttest} = 5.0$, $\underline{M}_{diff} = .2$; $\underline{t}\,(10) = 1.4$, $\underline{p}$ = NS). The self-report items were rated on 7-point scales where "1" represented *not al all*, "3" represented *somewhat*, "5" represented *comfortable*, *knowledgeable*, or *confident*, and "7" represented *not at all*.

Table 9. Mean Results from Evaluating the Z-track Injection Administration Courseware

13-point Knowledge Pretest score	13-point Knowledge Posttest score	Knowledge Gain score	Pre-rating of comfort using computers 1- not at all, 7- very	Post-rating of comfort using computers 1- not at all, 7- very	Change in comfort rating using computers 1- not at all, 7- very	Instructional preference	Time on task in minutes (n = 10)
6.0 (sd = 2.6)	10.5 (sd = 2.3)	4.5 ($p < .0005$)	4.7 (sd = 1.7)	5.2 (sd = 1.1)	.5 (p = NS)	Pre-measure 20% CBT 50% Lecture 30% CAI Post-measure 50% CBT 30% Lecture 20% CAI	36.4 (range 30-45)

Student instructional preferences changed dramatically after experiencing the computer-based lesson compared to before the experience. Twenty percent of students preferred the lesson on Z-track injection presented as self-paced CBT before actually experiencing the lesson. Following the lesson, 50% of the students preferred the lesson as self-paced CBT.

There was no effect of hands-on practice (before post-measures versus after post-measures) for knowledge and confidence self-ratings. However, average self-ratings tended to be in the expected direction (Knowledgeable: $\underline{M}_{\text{Hands-on}} = 3.8$, $\underline{M}_{\text{No hands-on}} = 3.7$; Confident: $\underline{M}_{\text{Hands-on}} = 3.4$, $\underline{M}_{\text{No hands-on}} = 3.2$).

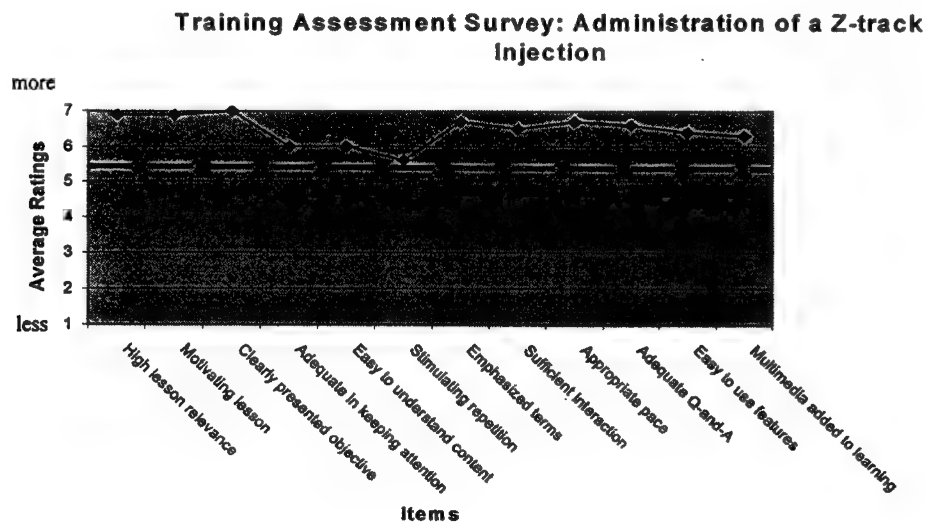


Figure 10. Training Assessment Survey Results for Z-track Injection Courseware

Results from the training assessment survey are presented in Figure 10. Students rated the survey items, aspects of sound instruction, on a 7-point scale. Reciprocal descriptors anchored the scale end-points, for example, sufficient and insufficient, adequate and inadequate, stimulating and boring. Low numbers signified *unacceptable* ratings and high numbers signified *acceptable* ratings. Average ratings below "5" indicate aspects of the courseware that need improvement.

Lesson relevance received a sufficiently high rating (M = 6.9) to validate all ratings. Overall the courseware received very high acceptability ratings from the students. Students rated all aspects of the courseware near "6." Only the *sufficient amount of interaction for learning* (M = 5.6) received an average rating below "6." None of the items received an unacceptable rating below "5."

Discussion

Administering a Z-track Injection courseware produced a 75% increase in student factual knowledge about the injection procedure. An average of 28% savings in class time was found with the courseware. The courseware also provided a positive learning experience for the students.

Twice as many students expressed a preference for self-paced CBT after they completed the courseware. The courseware produced increases in students' knowledge and confidence administering a Z-track intramuscular injection. The point in instruction at which hands-on practice occurred had no effect on students' self-ratings of knowledge and confidence administering the injection.

DISCUSSION

Students' Needs

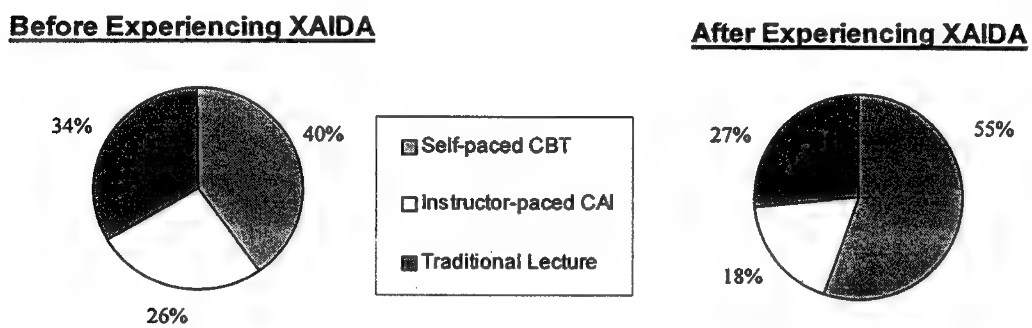
Students need more computer-based instruction for learning. This is evidenced in the effectiveness with which the students learned from the ICW developed by their instructors. All XAIDA courseware was instructionally sound. Instructional effectiveness of the courseware was evaluated as—how much the students learned, the efficiency with which they learned, and how they reacted to the learning experience. XAIDA courseware produces a broad range of knowledge gain scores. Increases in knowledge gain scores from 8% to 125% were found across the different topics presented in the courseware.

The eight evaluations reveal a substantial timesaving in almost every classroom. The best case was an average timesaving of 40% compared to a nominal 50-minute class period. Timesaving in the classroom benefits students. Extra time allows for one-on-one instruction and additional hands-on practice. The worst case was zero savings when using the courseware as CAI. However, there are benefits to students, as well as instructors, when ICW is implemented as CAI. For instance, students get exposure to computer-based instruction with CAI in the cases where a department may not have computer resources to deliver courseware as stand-alone instruction. In addition, instruction is standardized. Courseware can be used for remedial

purposes as self-paced CBT by students who need to makeup a class or as tutorials for students who want to review a class.

The 117 community college students, faculty, and staff who participated in the classroom evaluations report a generally positive learning experience. The students show a readiness for computer-based instruction as part of their regular curriculum. Before participating in the evaluation, 61.8% of students report being "comfortable using computers." After their participation, 75.3% of students report being "comfortable using computers."

Of real interest is the shift in instructional preferences expressed by students. Seventy-three percent of student-participants express a preference for computer-based instruction over traditional classroom instruction after they experience ICW. It seems that once students realize that they can learn from computers, then they are more willing to use computer-based instruction. The chart below shows the breakdown of student preferences into instructional categories. There is a noticeable shift in preferences toward self-paced CBI. After participating in the evaluation 55% of students show a preference for self-paced CBI; whereas, before the evaluation only 40% of students show a preference for self-paced CBI.

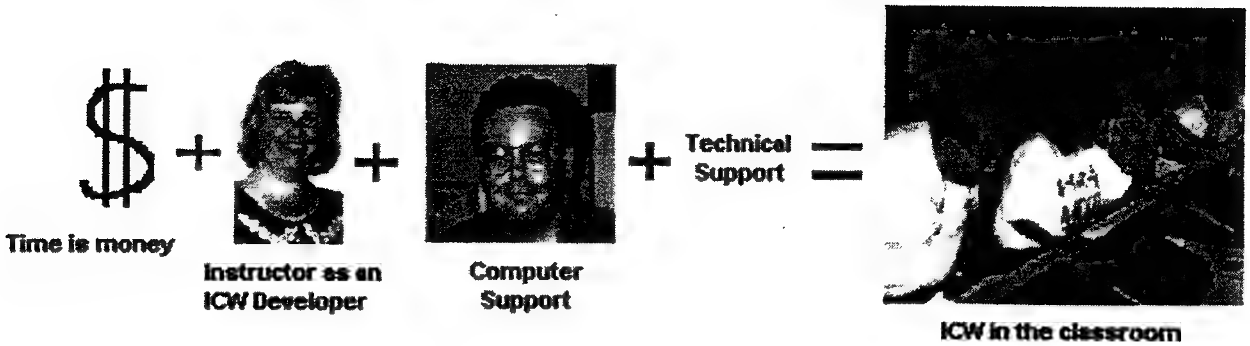


Instructors' Needs

Community college instructors have the wherewithal to develop ICW for use in their classrooms. However, the instructor alone can not complete the development and implementation process. The process requires technical support and assistance from computer staff and perhaps instructional technology staff. Instructors need resources and training to become proficient at courseware development and knowledgeable about courseware implementation and evaluation. Instructors need to find additional time to develop ICW, have access to multimedia resources, know what it means to audit computer lab equipment, and work with the computer lab staff at the start of courseware development and throughout the implementation process.

What's Next?

Below is an equation for a successful program aimed at empowering instructors with the skills to develop and implement computer-based instruction in community college curricula.



Continued increase in the use of computer-based instruction to facilitate learning at vocational and technical institutions requires some planning on the part of those involved in the early programs. Faculty and staff within the educational institutions need to be included in planning the movement toward computerized instruction. As well, organizations that hire graduates should be included in the planning. A potential exists to form partnerships with industry for courseware development and distribution. Interactive multimedia courseware developed by community college instructors for classroom training is likely applicable to training programs in industry.

Critical to successfully incorporating computers in instruction is transforming "new programs" into "new ways of thinking."

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APPENDIX A EXAMPLE OF AN EVALUATION BOOKLET

The instructional effectiveness of the computer-based training lessons developed with the Experimental Advanced Instructional Design Advisor (XAIDA) is of interest to the Alamo Community College District. Mei Technology Corporation has been tasked with evaluating the effectiveness of XAIDA as it contributes to technical training.

PROJECT DESCRIPTION

You will experience a computer-based lesson. Before and after the experience written performance data will be collected. The data you provide will be used to help improve the instruction others receive at the community college level.

The data you provide is completely confidential. We ask that you not place any identifying marks on the response sheets. Information collected will not be part of your official record. Only group statistics will be reported. Information will not be divulged to anyone who is not a member of the research team.

Your voluntary participation is sincerely appreciated. There are no potential risks associated with participation in this research. You may choose not to participate at any time.

I agree to participate in the research project described above.

____

Signature | Date

Please complete the items below

1. Choose the way you would prefer to learn how to install RAM (circle one):

   (A) self-paced, computer-based training
   (B) group-paced, instructor-lead class lecture
   (C) instructor-paced, computer-assisted learning

2. Rate your comfort learning from computers (circle the number that represents your response).

   1---------------2---------------3---------------4---------------5---------------6---------------7

Not at all comfortable	Somewhat comfortable	Comfortable	Very comfortable

3. Rate your knowledge of how to install RAM.

   1---------------2---------------3---------------4---------------5---------------6---------------7

Not at all knowledgeable	Somewhat knowledgeable	Knowledgeable	Very knowledgeable

4. Rate your confidence in applying your knowledge to install RAM.

   1---------------2---------------3---------------4---------------5---------------6---------------7

Not at all confident	Somewhat confident	Confident	Very confident

5. How confident are you in your overall computer skills?

   1---------------2---------------3---------------4---------------5---------------6---------------7

Not at all confident	Somewhat confident	Confident	Very confident

6. Do not place you name on this booklet. Instead, enter the last four digits of you SS#
   __________.

7. Turn the page and complete the pretest. Wait for instructions after completing the pretest.

Pretest A

1. List the four steps to installing RAM

2. The "skin" of the CPU refers to the _______________.

   A. RAM chips
   B. SIMM chips
   C. case
   D. clear plastic cover

3. RAM stands for….

   A. Read And Memorize
   B. Random Access Memory
   C. Read And Write Memory
   D. None of the above

4. The proper way to handle a SIMM chip is …

   A. only in the wrapper
   B. by the top and bottom
   C. by the pins
   D. by the sides

5. ___________ is the standard RAM found in home computers that have not been upgraded.

   A. 8-16 MB
   B. 200 Hz
   C. 16-32 MB
   D. 100 Hz

6. Where are the RAM slots located on the motherboard?

   A. usually opposite the power supply
   B. directly next to the power supply
   C. on the microprocessing chip
   D. between expansion slots

7. RAM speed is measured in…

   A. milliseconds
   B. nanoseconds
   C. microseconds
   D. picoseconds

8. A WARNING when installing RAM is…

   A. don't touch the CPU
   B. don't touch the pins on the SIMM chip
   C. don't unplug the computer
   D. don't close the software applications

9. SIMM chips are typically….

   A. 32-pin and 70-pin
   B. 8-pin and 16-pin
   C. 30-pin and 72-pin
   D. 16-pin and 256-pin

10. When installing and setting the SIMM chip you need to pay attention to:

   A. pin-one position
   B. proper handling of the chip
   C. the notch
   D. all of the above

11. What is the last thing you do before closing the CPU?

   A. reformat the hard drive
   B. turn the computer on as a memory test
   C. discharge the static electricity
   D. all of the above

TO OPEN THE LESSON:

Type your initials in the NAME box and the last four digits of your SS# in the ID box.

Click the SIGN IN button on the left.

Read the following instructions while waiting for the lesson to open.

Click the NEXT button to move forward through the lesson.

Click the BACK button to review the previous screen.

To continue the lesson after viewing a graphic, click the CONTINUE button.

When in practice, make your response to an item and click the DONE button.

To move on to the next practice item, click the OK button (perhaps more than once) after viewing your feedback.

If you want to return to the lesson to look up an answer click the LOOK UP button. You need to click the RETURN TO PRACTICE button to make your response.

COMPLETE THE LESSON AND PRACTICE EXERCISES

Write any comments you have about the lesson here:

AFTER THE LESSON TURN THE PAGE AND TAKE THE POSTTEST

Posttest B

1. List the four steps to installing RAM

2. The most important pin on a SIMM chip is:

    A. the last pin
    B. Pin-16
    C. internal power pin
    D. pin-one

3. CPU stands for....

    A. Common Processing Unit
    B. Common Program Unit
    C. Central Processing Unit
    D. None of the above

4. You are mishandling the SIMM chip if you hold it ...

    A. in its anti-static wrap
    B. by the pins
    C. by the sides
    D. all of the above

5. The maximum capacity of RAM can be expanded to...

    A. 256 MB
    B. 200 Hz
    C. 64 MB
    D. 100 Hz

6. RAM slots are located ________________.

   A. on the power supply
   B. directly next to the power supply
   C. on the microprocessing chip
   D. on the motherboard

7. Nanoseconds are used to measure:

   A. SIMM chip size
   B. SIMM chip capacity
   C. SIMM chip speed
   D. all of the above

8. A NOTICE when installing RAM is…

   A. don't forget to discharge the static electricity
   B. don't forget to check the manual
   C. don't unplug the computer from the wall socket
   D. don't close the software applications

9. SIMM chips are typically….

   A. 32-pin and 70-pin
   B. 8-pin and 16-pin
   C. 30-pin and 72-pin
   D. 16-pin and 256-pin

10. Pin-one position:

   A. defines size and speed of the SIMM chip
   B. determines proper handling of the chip
   C. determines proper SIMM chip alignment
   D. defines the type of SIMM chip

11. What is the first thing you do before opening the CPU?

   A. unplug all external peripherals
   B. turn the computer off
   C. open SIMM installation software
   D. discharge static electricity

Circle the number that represents your response.

1. Rate your comfort learning from computers.

1---------------2---------------3---------------4---------------5---------------6---------------7

Not at all comfortable	Somewhat comfortable	Comfortable	Very comfortable

2. Rate your knowledge of how to install RAM.

1---------------2---------------3---------------4---------------5---------------6---------------7

Not at all knowledgeable	Somewhat knowledgeable	Knowledgeable	Very knowledgeable

3. Rate your confidence in applying your knowledge to install RAM.

1---------------2---------------3---------------4---------------5---------------6---------------7

Not at all confident	Somewhat confident	Confident	Very confident

4. How confident are you in your overall computer skills?

1---------------2---------------3---------------4---------------5---------------6---------------7

Not at all confident	Somewhat confident	Confident	Very confident

CONTINUE

Circle the NUMBER that best represents your opinion. Note the scale end-points!

1. The lesson features (buttons, hot boxes, practice) were _______________ to use.

Easy 1----------2---------3---------4---------5----------6---------7 **Difficult**

2. The lesson objective was _______________ presented.

Clearly 1----------2---------3---------4---------5----------6---------7 **Not clearly**

3. The instructional sequence was _______________ in keeping my attention.

Inadequate 1----------2---------3---------4---------5----------6---------7 **Adequate**

4. The lesson was _______________ to understand than I would have liked it to be.

More difficult 1----------2---------3---------4---------5----------6---------7 **Easier**

5. Repetition of lesson content was...

Stimulating 1----------2---------3---------4---------5----------6---------7 **Boring**

6. Terms, concepts, and information that were important to know were emphasized...

Effectively 1----------2---------3---------4---------5----------6---------7 **Ineffectively**

7. Question-and-answer sessions were _______________ for learning.

Inadequate 1----------2---------3---------4---------5----------6---------7 **Adequate**

8. The multimedia (graphics, audio, video) ___________ learning.

Add to 1----------2---------3---------4---------5----------6---------7 **Detracted from**

9. The amount of interaction (with students, instructor, computer) was _______________ for learning.

Insufficient 1----------2---------3---------4---------5----------6---------7 **Sufficient**

10. The pace of the lesson was _______________ for learning.

Inadequate 1----------2---------3---------4---------5----------6---------7 **Adequate**

11. Overall the lesson was...

Motivating 1----------2---------3---------4---------5----------6---------7 **Unmotivating**

12. This lesson was _______________ to my education.

Irrelevant 1----------2---------3---------4---------5----------6---------7 **Relevant**

13. I would prefer that the lesson on how to install RAM be presented as (circle one):

(A) self-paced, computer-based training
(B) group-paced, instructor-lead class lecture
(C) instructor-paced, computer-assisted learning